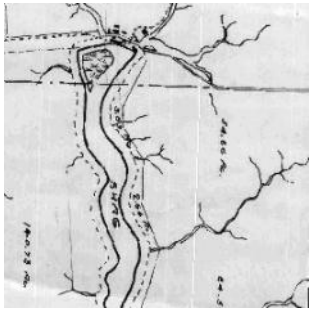









Tools for Landscape-Scale Restoration Planning in the Delta

Presentation to the Delta Independent Science Board

Letitia Grenier
Robin Grossinger

San Francisco Estuary Institute-Aquatic Science Center
Funded by the Ecosystem Restoration Program
January 16, 2013

AQUATIC SCIENCE CENTER

Historical ecology is:

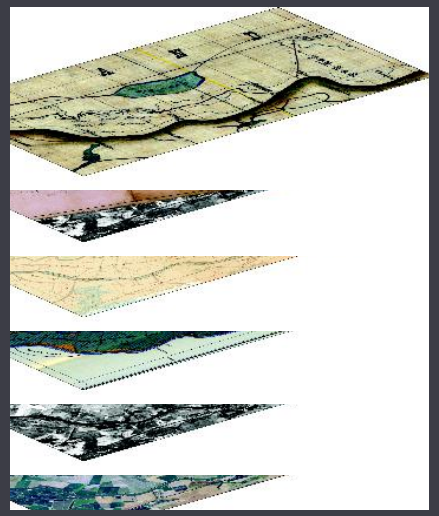
Using the past to understand the present landscape and assess its future potential

- **Links landscape pattern, process, and function**
- **Describes the conditions to which species are adapted**
- **Challenges assumptions about past landscapes**
- **Identifies opportunities and constraints**

Historical ecology is not:

Not about prescriptive management

Not about recreating the past!



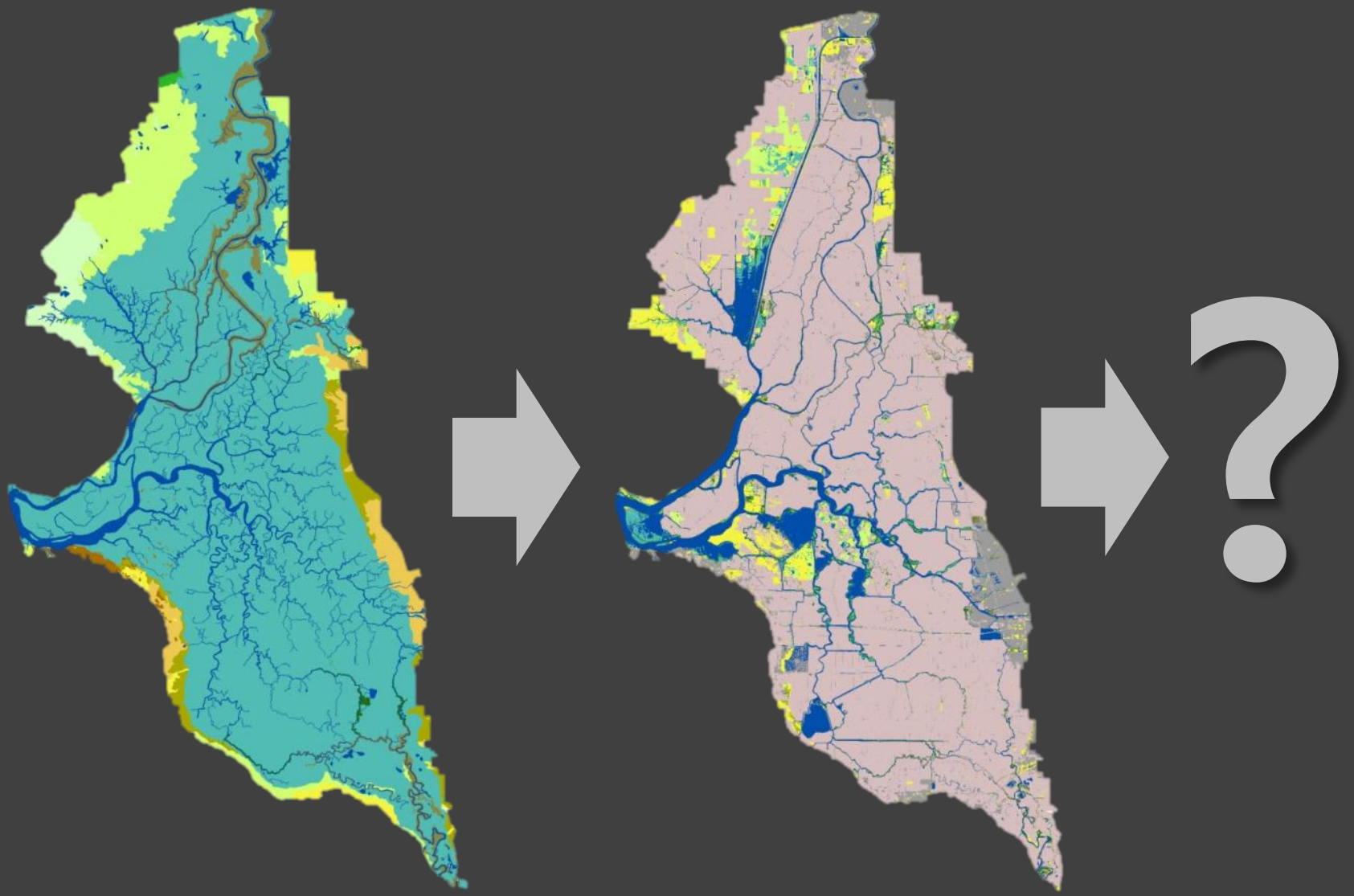
Not just the “way things were,” but the “way things work” (Safford et al. 2012)

(See also: *“The Growing Importance of the Past in Managing Ecosystems of the Future”* (Safford, Wiens, and Hayward 2012))

Historical conditions can no longer be attained…
(ISB 2013)

but need to reestablish historical functions and processes.

How do we create ecologically functional, resilient *landscapes*? (not just nice projects)



- “Extensive **wide bands or large patches** of interconnected valley/foothill riparian forests…”
- “Produce **sinuous, high-density**, dendritic networks of tidal channels through tidal areas…”
- “Restore and sustain **a diversity of marsh vegetation** …”

-- Bay Delta Conservation Plan draft

*"Restore **large areas** of **interconnected habitats** within the Delta and its watershed by 2100"*

- Water Code section 85302

*"Restoration of the health of the Delta's ecological systems by addressing **ecological functions and processes at a broad landscape scale**"*

- Bay Delta Conservation Plan draft

*"Management plans and decisions need to be informed by a **landscape perspective** that recognized interrelationships among patterns of land and water use, patch size, location and connectivity, and species success."*

- Delta Plan draft

- How large is large?
- What should be connected to what? (and how)
- What is the whole that the parts add up to?
- And how does that look in different parts of the Delta?

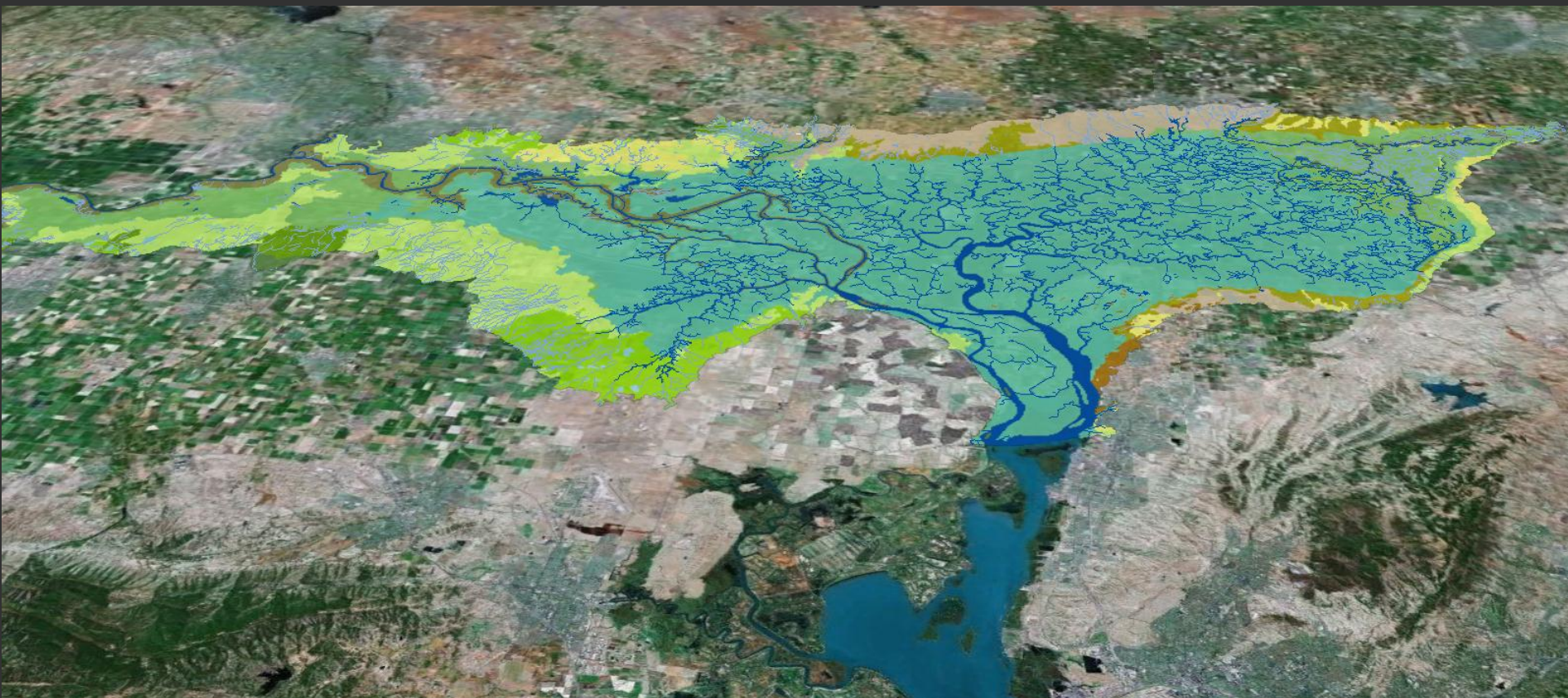
→ a landscape vision

Central concept

Use an understanding of pattern and process…

to inform landscape scale restoration…

that supports ecological function



Approach is supported in the literature

"… the first step in a river restoration program should be to develop a solid understanding of what the targeted rivers were actually like…

Montgomery 2008

"Where was habitat historically, and how did that distribution differ from today? What were the geomorphic processes that created the habitat, and how do those processes differ today?" **Collins and Montgomery 2001**

Use HE to identify "landscape components" as "building blocks for restoration"

Verhoeven et al. 2008

"Historical understanding" necessary to distinguish "historical," "hybrid," and "novel" ecosystems– and associated restoration trajectories.

Hobbs et al. 2009

Use HE "to operationally define concepts like "ecological integrity" and "resilience"…" **Safford et al. 2012**

"Knowledge of the past therefore seems to have an impact on preferences for future landscapes." **Hanley et al. 2008**

Background

- **Delta Historical Ecology Investigation** (Whipple et al. 2012)

- **Delta Landscapes Project**
  - *Management Tools for Landscape-Scale Restoration of Ecological Functions*
  - Full Delta
  - 2012-2015 (funded by ERP through DFW)

- **Application of HE to the McCormack-Williamson Tract**
  - Beagle et al. 2012 (funded by TNC)
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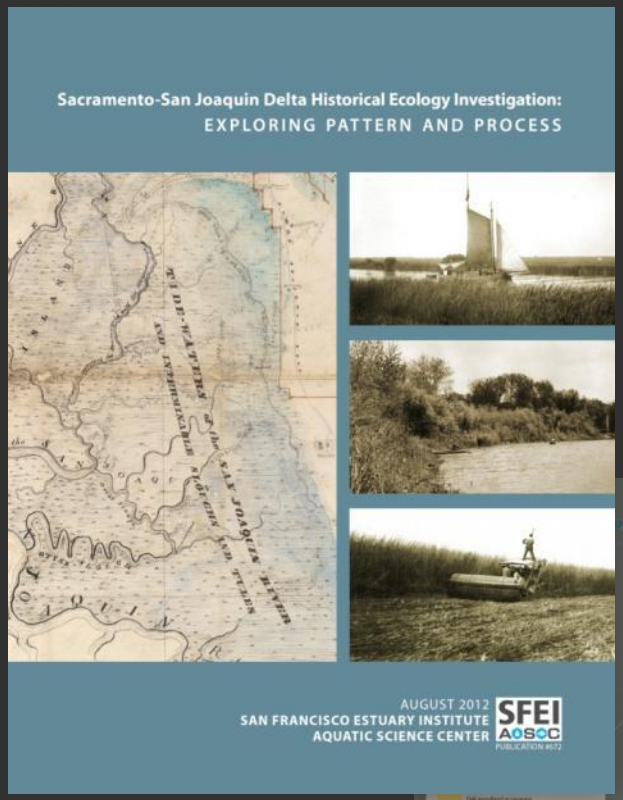
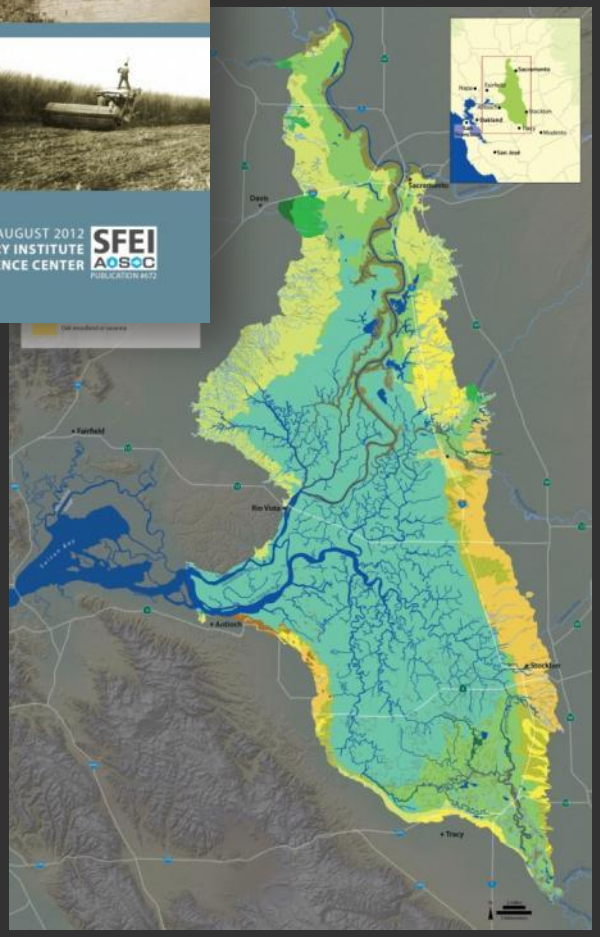


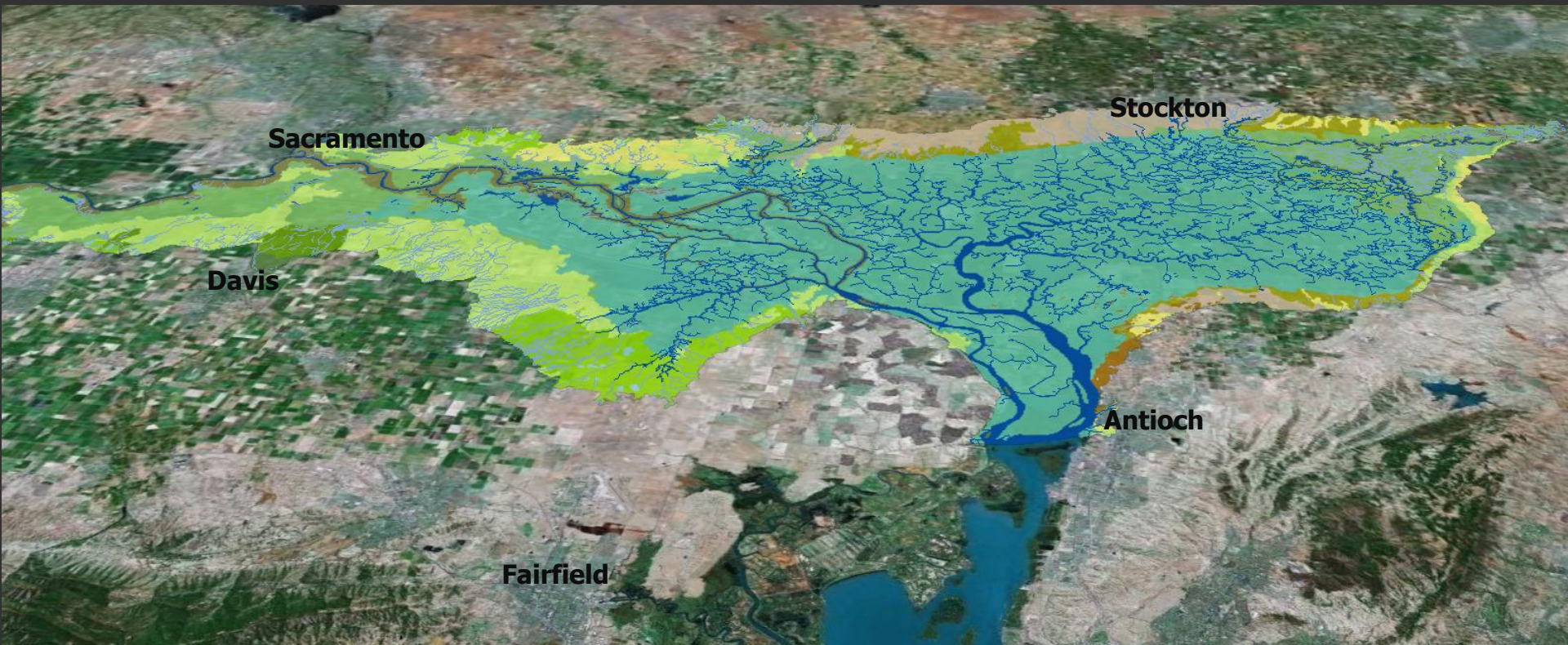
Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process



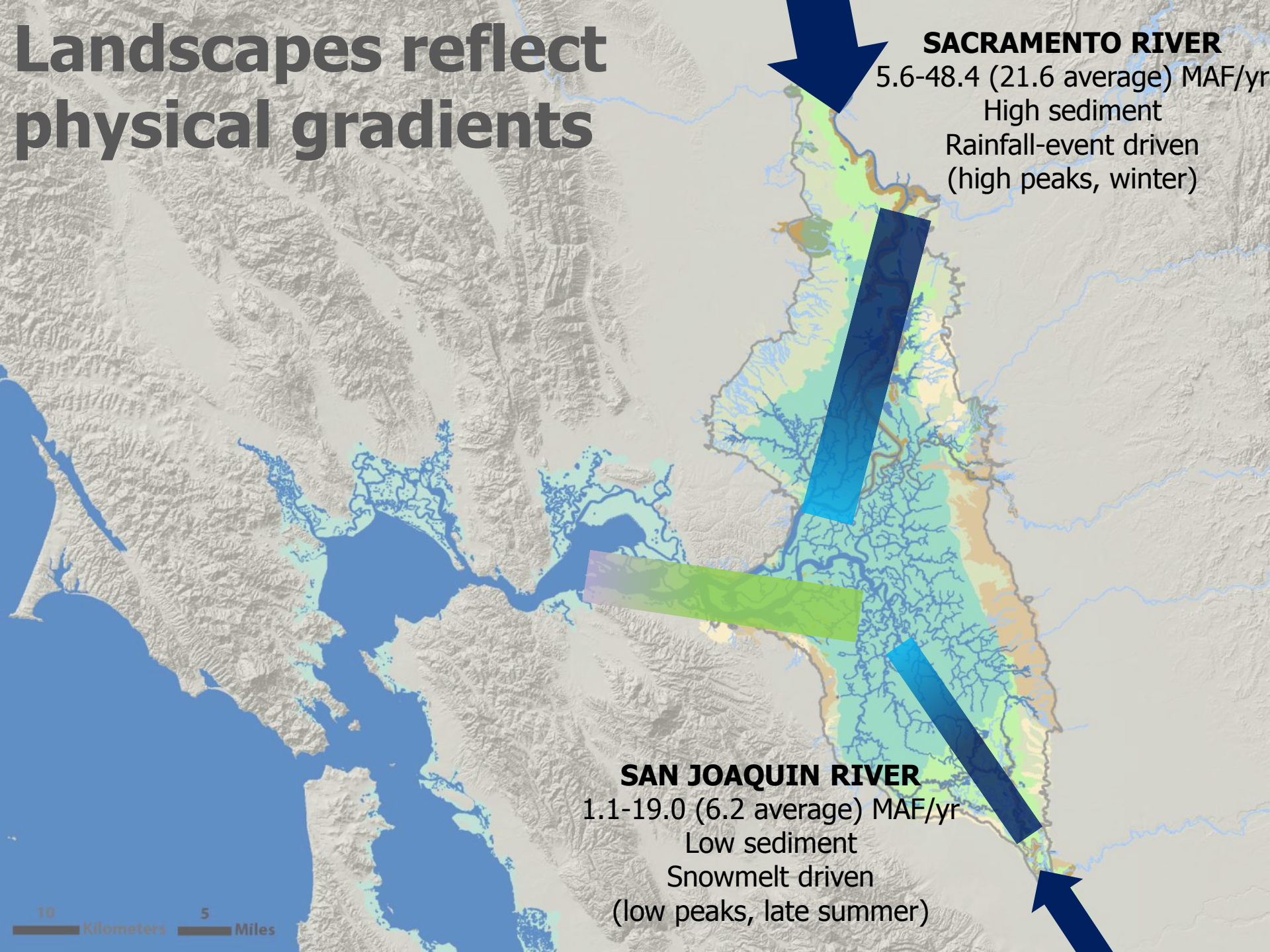
- Funded by Ecosystem Restoration Program (CDFG, NOAA, US FWS)
- Final Report/GIS Available: www.sfei.org/DeltaHEStudy
- Collaboration with KQED QUEST and Stanford's Bill Lane Center for the American West: science.kqed.org/quest/delta-map/

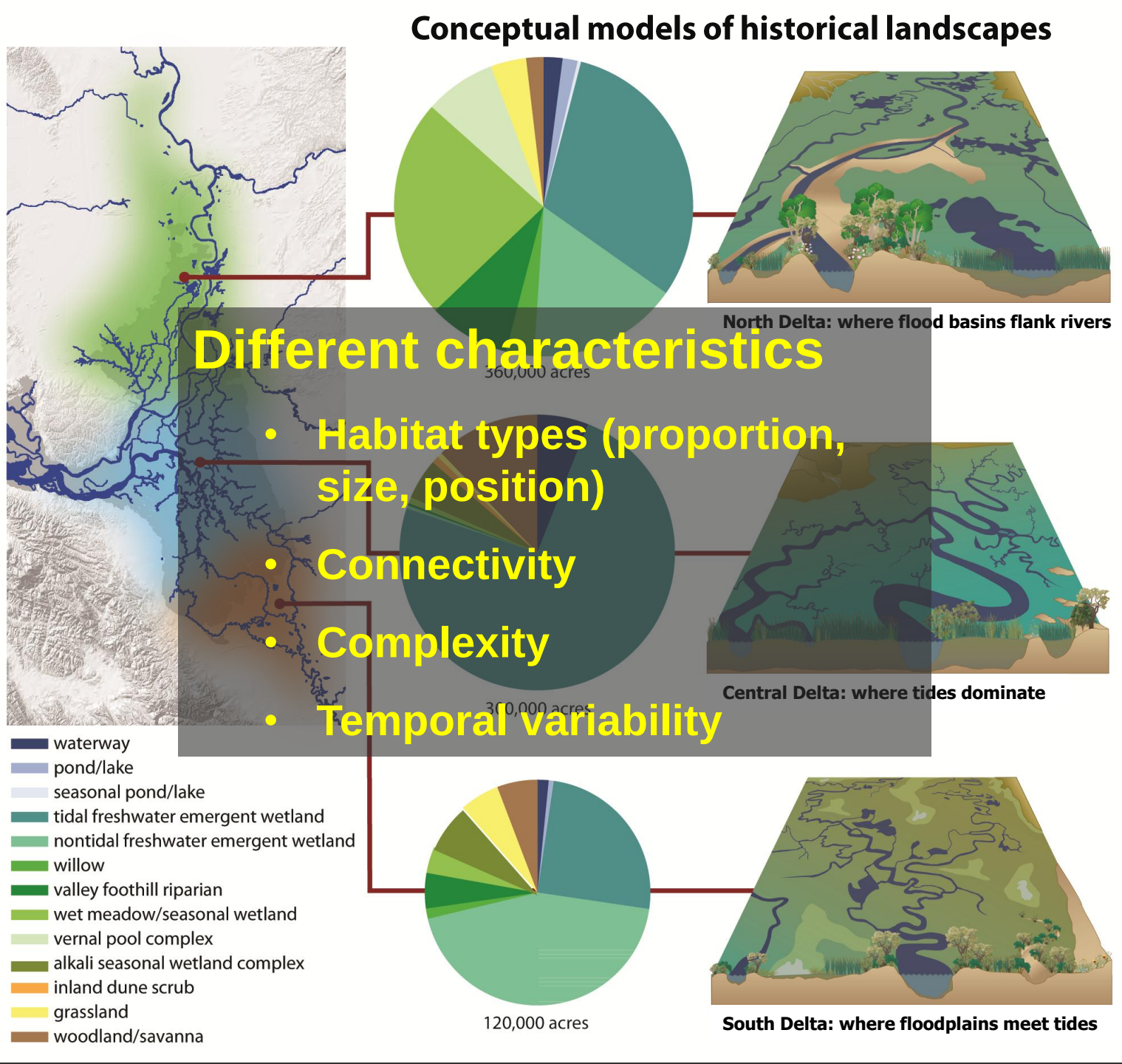
key points

- Multiple landscapes
  - Habitat mosaics arranged in distinct patterns
  - Expressed across broad physical gradients

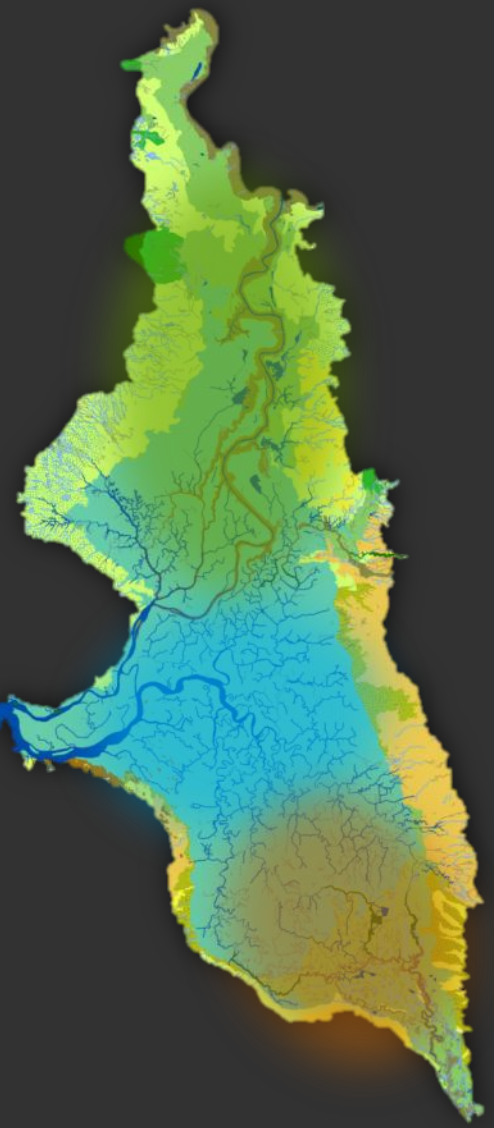


Landscapes reflect physical gradients



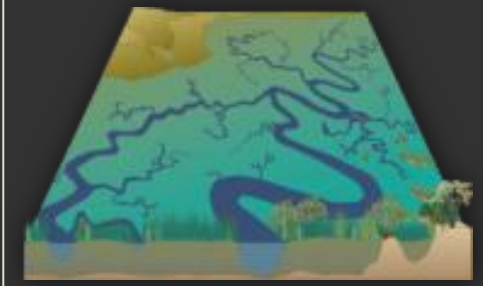

Conceptual models of historical landscapes
Different characteristics
• Habitat types (proportion, size, position)
• Connectivity
• Complexity
• Temporal variability
waterway
pond/lake
seasonal pond/lake
tidal freshwater emergent wetland
nontidal freshwater emergent wetland
willow
valley foothill riparian
wet meadow/seasonal wetland
vernal pool complex
alkali seasonal wetland complex
inland dune scrub
grassland
woodland/savanna
360,000 acres
300,000 acres
120,000 acres
North Delta: where flood basins flank rivers
Central Delta: where tides dominate
South Delta: where floodplains meet tides

Delta Historical Landscapes summary



- Floods wetted and connected landscape
- Channels to lakes along gradient
- Riparian forest bordering tule basins

- High degree of tidal influence
- Networks of branching channels
- Tidal wetland of tule and willow-fern swamp



- Floods within a complex landscape meet the tides
- Side-channels connected to rivers
- Habitat type diversity at local scale

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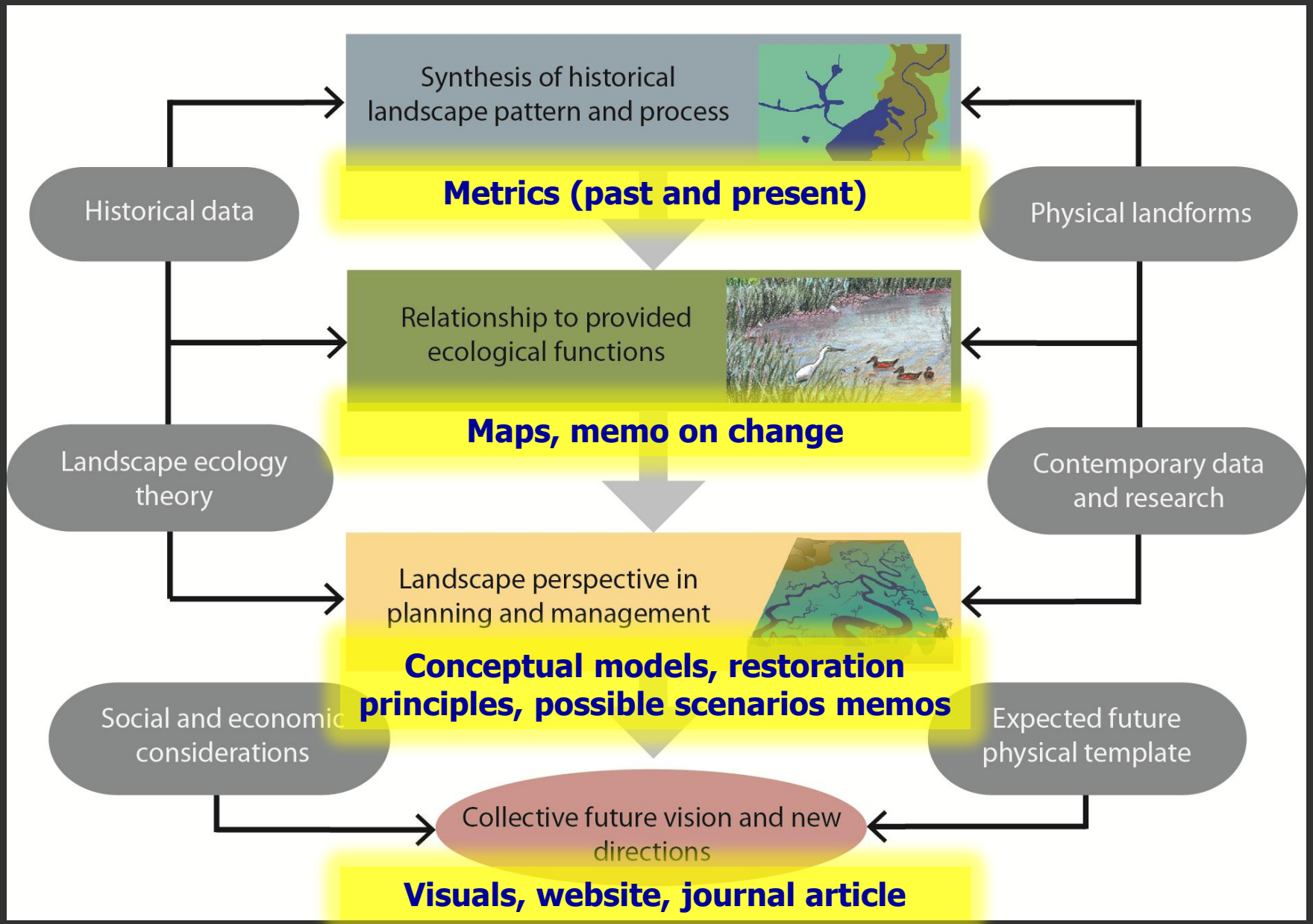
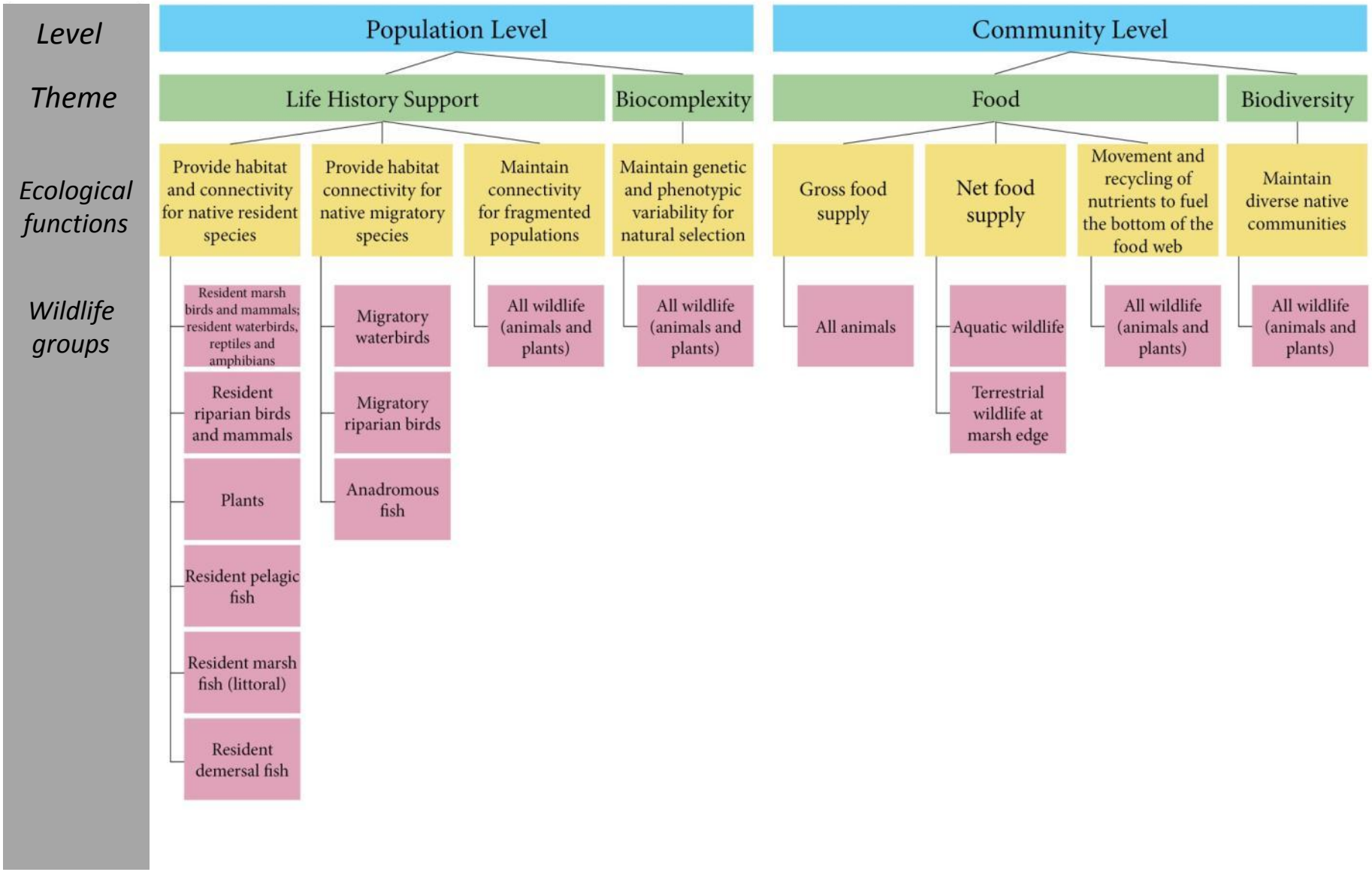
Goals and Objectives

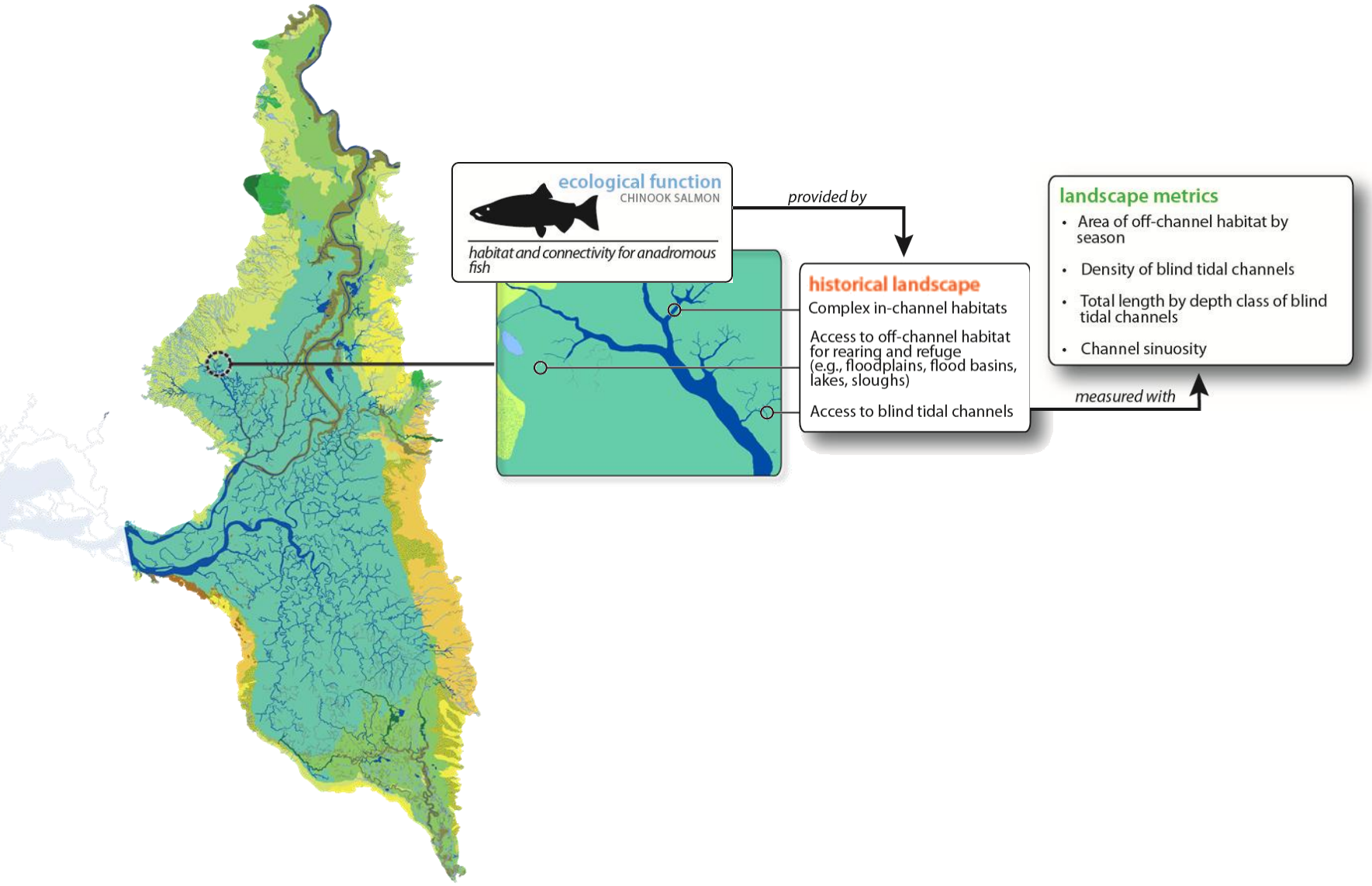


Landscape Interpretation Team

Stephanie Carlson (UC Berkeley)
Jim Cloern (USGS)
Brian Collins (University of Washington)
Chris Enright (Delta Science Program)
Joseph Fleskes (USGS)
Geoffrey Geupel (PRBO Conservation Science)
Todd Keeler-Wolf (CDFG)
William Lidicker (UC Berkeley)
Steve Lindley (NMFS)
Jeff Mount (UC Davis)
Peter Moyle (UC Davis)
Anke Mueller-Solger (IEP and Delta Science Program)
Eric Sanderson (Wildlife Conservation Society)
Dave Zezulak (CDFG)

Ecological Functions framework (Task 3)



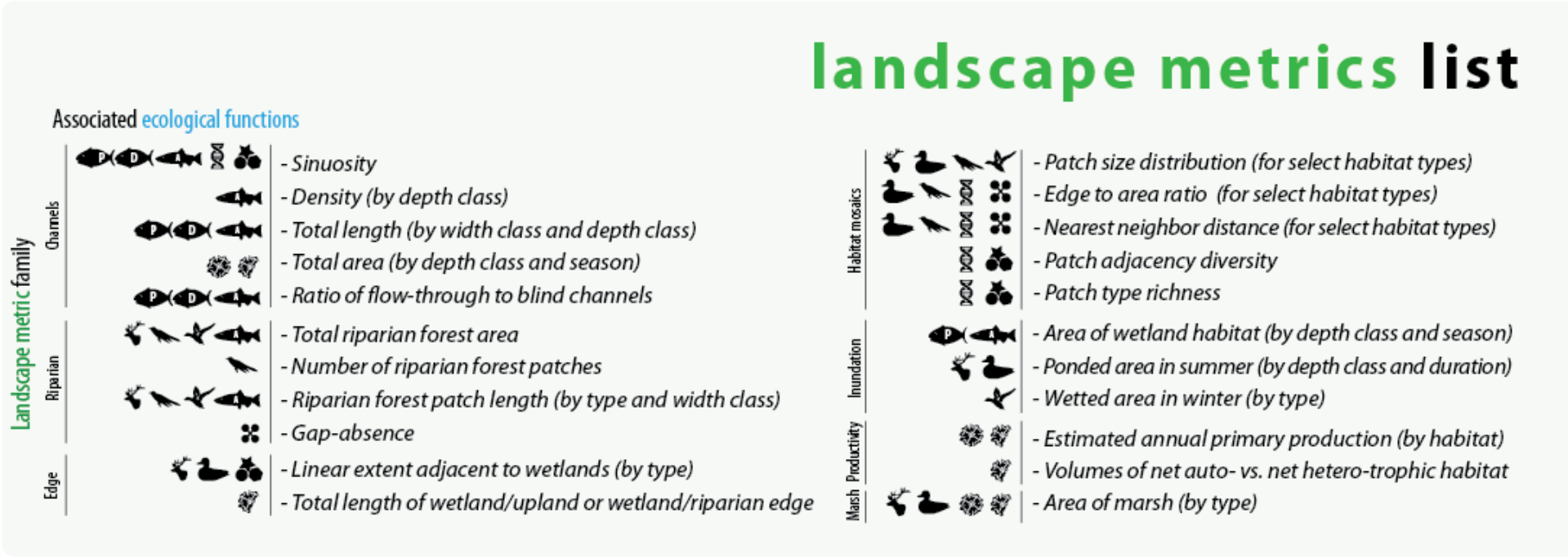

ecological function
CHINOOK SALMON
habitat and connectivity for anadromous fish
provided by
historical landscape
Complex in-channel habitats
Access to off-channel habitat for rearing and refuge (e.g., floodplains, flood basins, lakes, sloughs)
Access to blind tidal channels
measured with
landscape metrics
• Area of off-channel habitat by season
• Density of blind tidal channels
• Total length by depth class of blind tidal channels
• Channel sinuosity

Ecological Functions list (Task 3)

ecological functions list

				
Habitat and connectivity for pelagic fish	Habitat and connectivity for resident mammals	Habitat and connectivity for native plants	Maintain genetic/pheno typic diversity	Nutrient movement and recycling
				
Habitat and connectivity for demersal fish	Habitat and connectivity for marsh birds	Habitat and connectivity for anadromous fish	Maintain connectivity for fragmented populations	Gross food supply
				
Habitat and connectivity for littoral fish	Habitat and connectivity for riparian birds	Habitat and connectivity for migratory waterfowl	Maintain diverse native communities	Net food supply

Landscape Metrics list (Task 3)



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Ecofunction Metrics

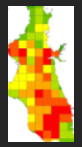
+

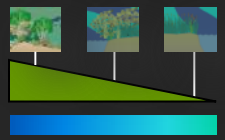
Physical Drivers & Gradients

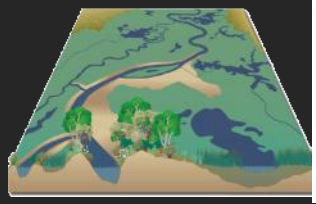
Conceptual Landscape Models

+

Existing & Projected Physical Settings







Operational Landscape Units
with specific Landscape Metrics and associated Ecological Functions at Regional and Subregional scale

- Conceptual design for restoration projects
- Performance measures
- Regional vision products
- Test thru research (field, modeling, experiments)

(Verhoeven et al. 2008)

Case study: McCormack-Williamson Tract

- **Opportunities**
- Large restoration opportunity
- Variable topography
- Connection to uplands and tides
- Remnant historical features

Case study:
McCormack-Williamson Tract

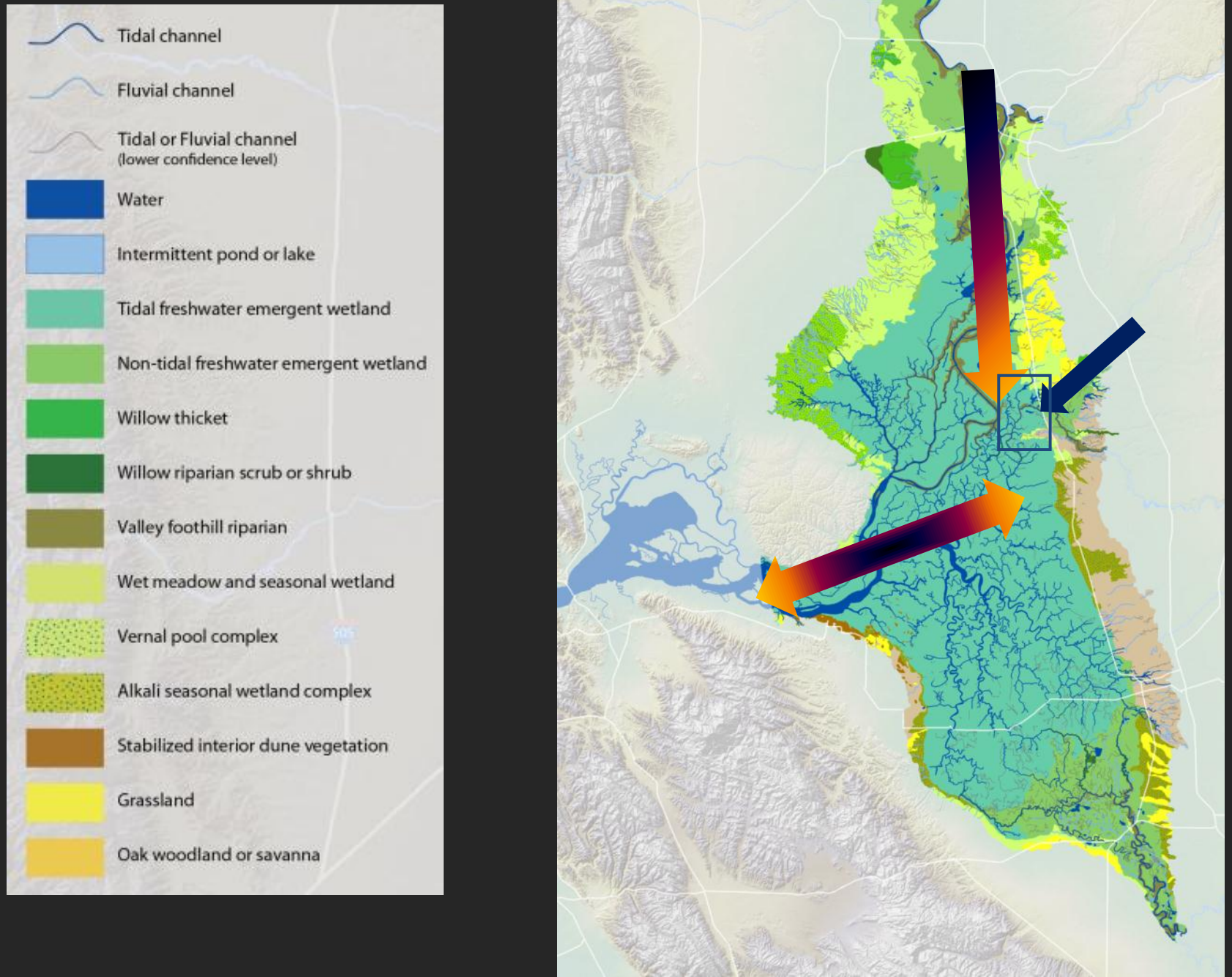
- **Constraints**
- Short term constraints
  - *Flooding bottleneck*
  - *$, process*
- Long term constraints
  - *Radio tower, access*
  - *Land ownership*

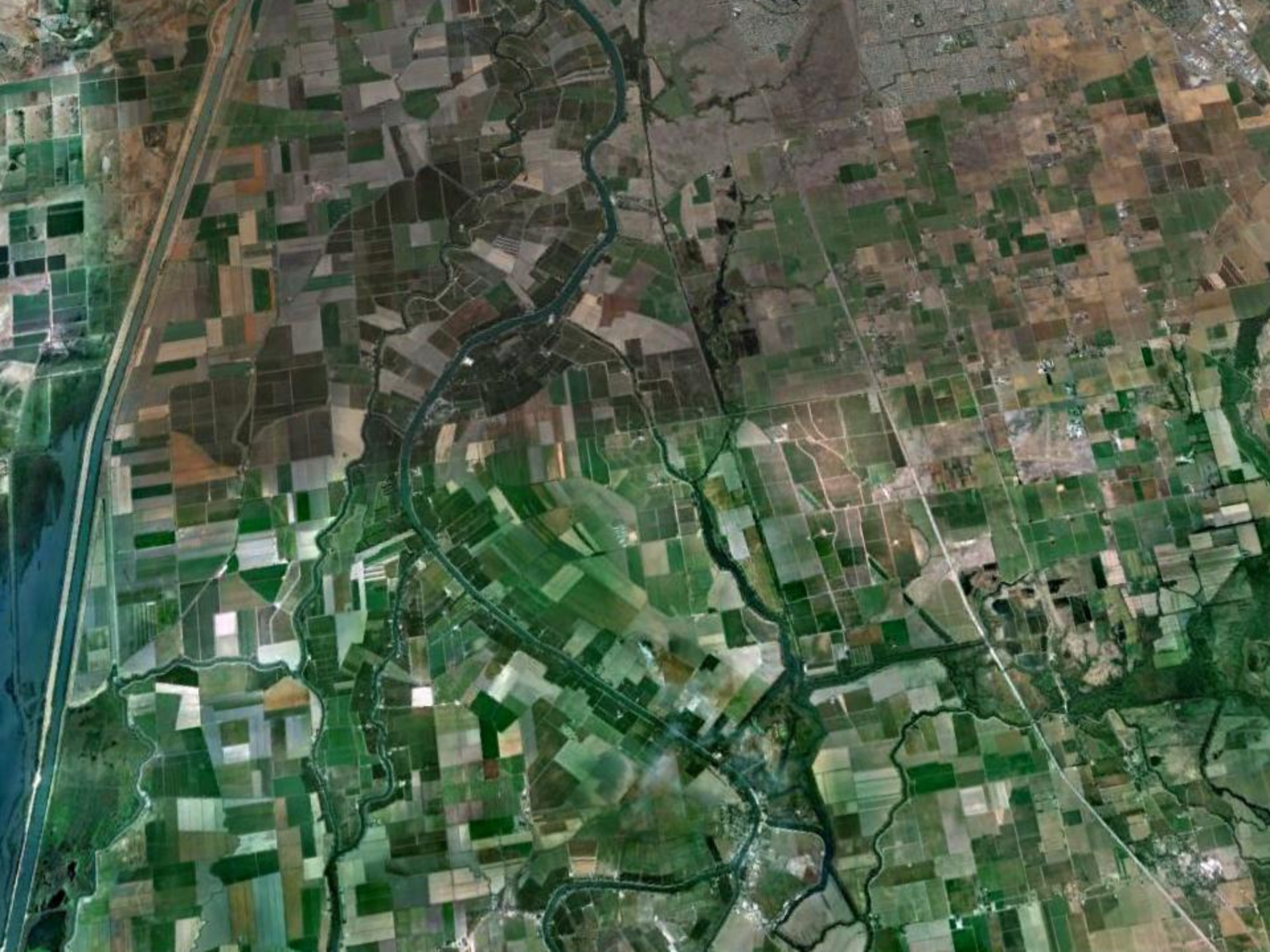
Translating historical ecology to landscape scale restoration

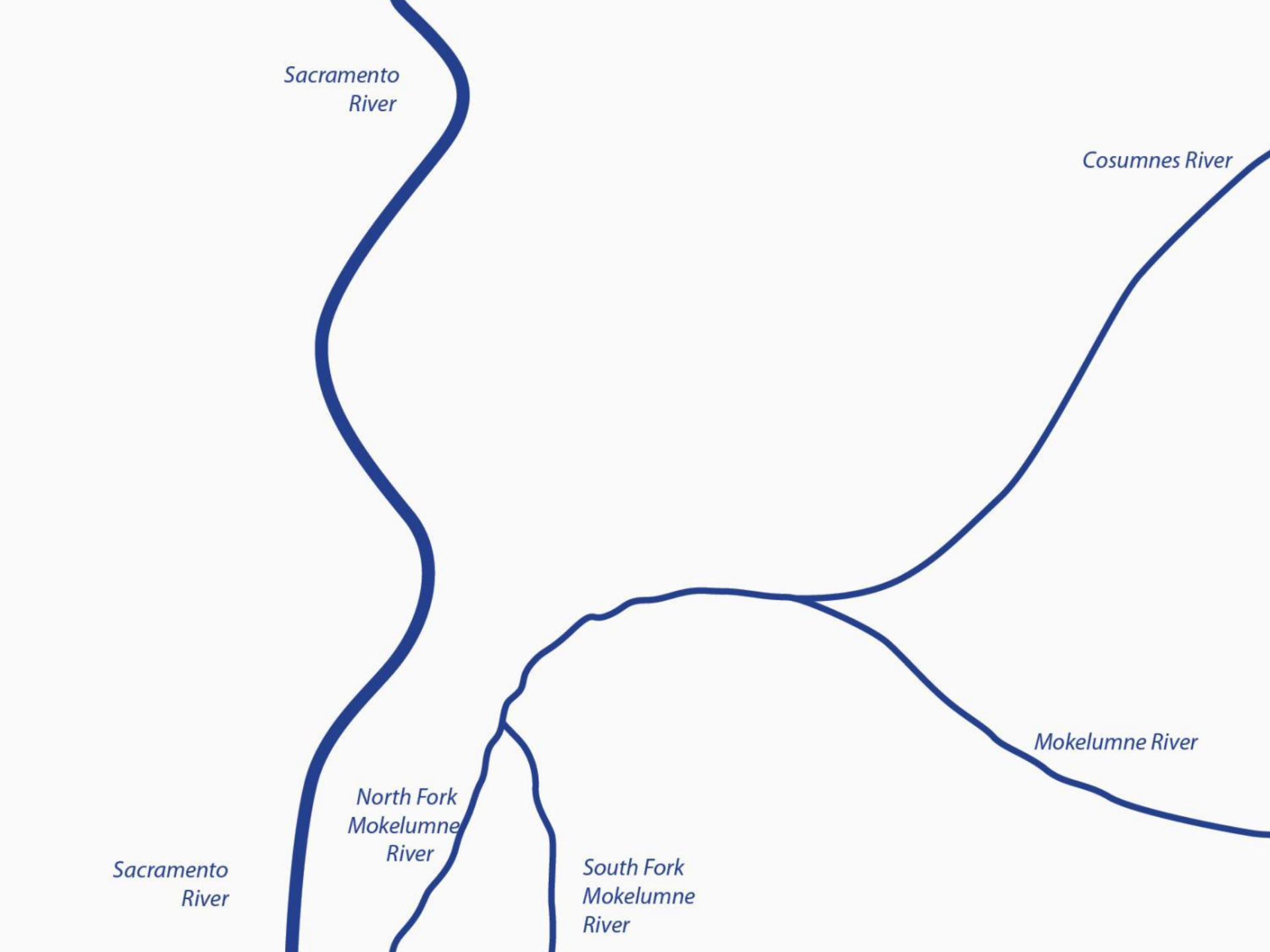
1) It is important to know how we got here:

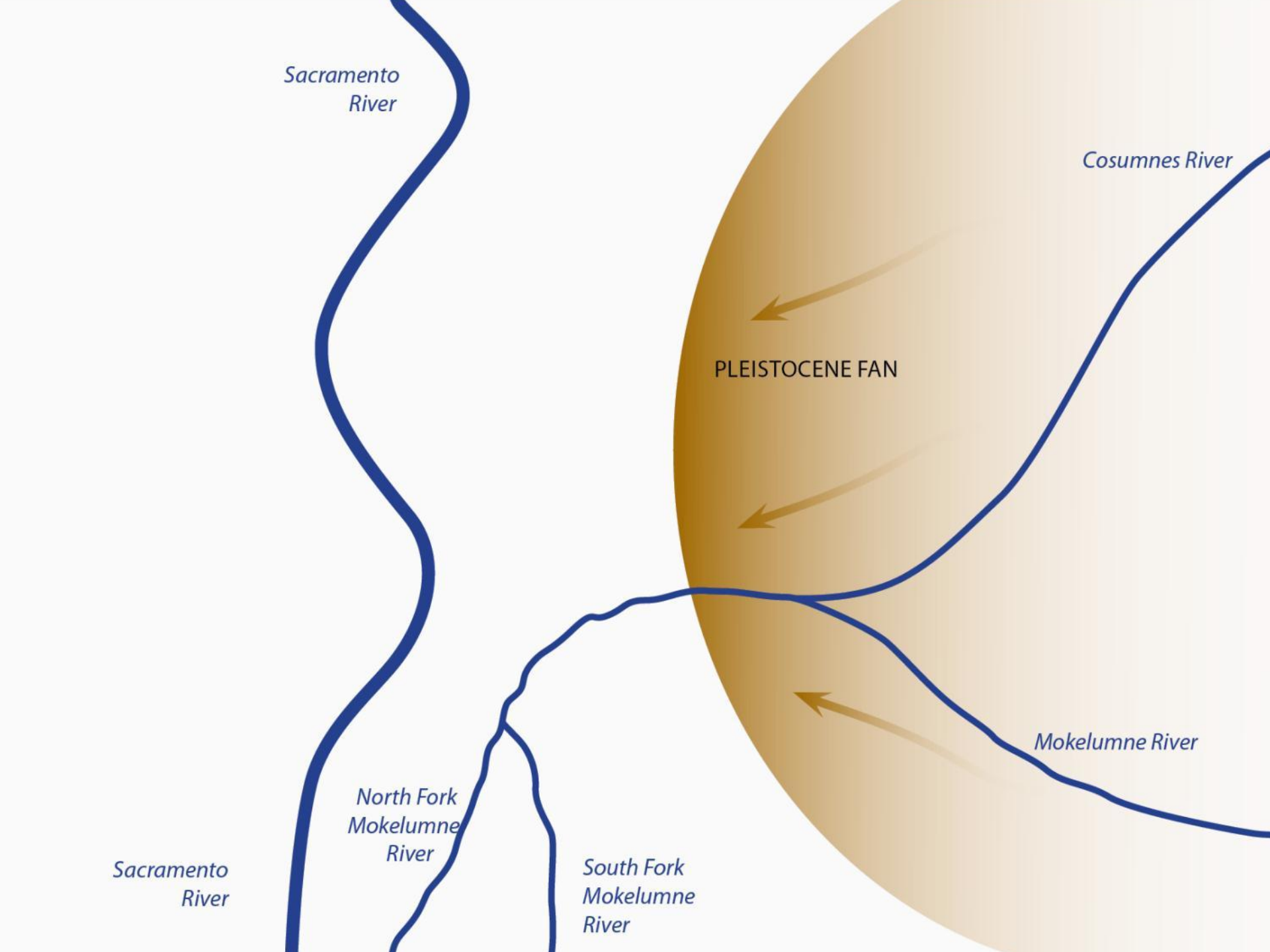
- How the formation of the tract underlies “constraints”
- What are the physical drivers of this landscape?
  - Transition between tidal/non-tidal, transition to upland habitat types etc.

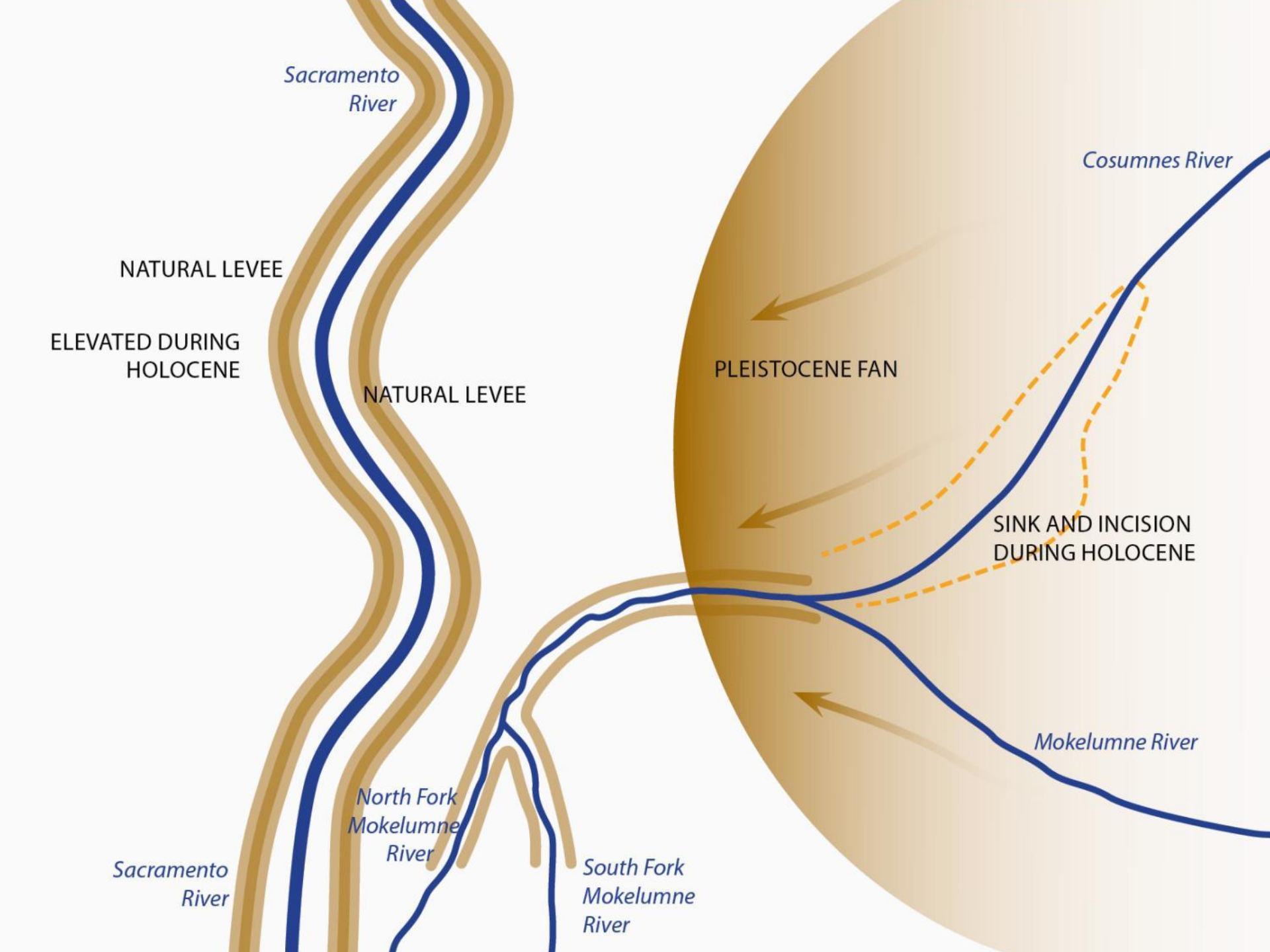
2) How do these drivers influence restoration potential?

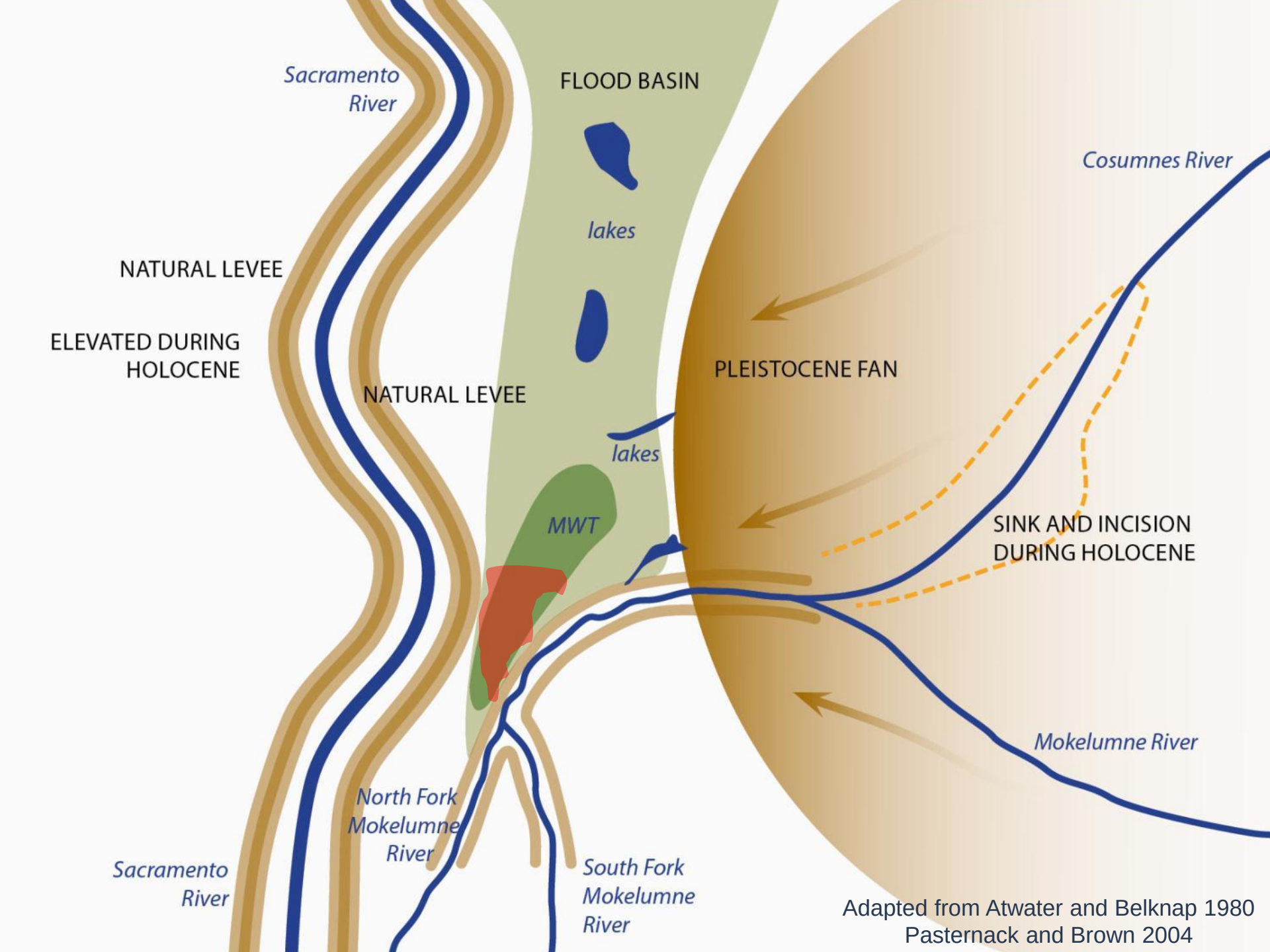

Tidal channel
Fluvial channel
Tidal or Fluvial channel
(lower confidence level)
Water
Intermittent pond or lake
Tidal freshwater emergent wetland
Non-tidal freshwater emergent wetland
Willow thicket
Willow riparian scrub or shrub
Valley foothill riparian
Wet meadow and seasonal wetland
Vernal pool complex
Alkali seasonal wetland complex
Stabilized interior dune vegetation
Grassland
Oak woodland or savanna



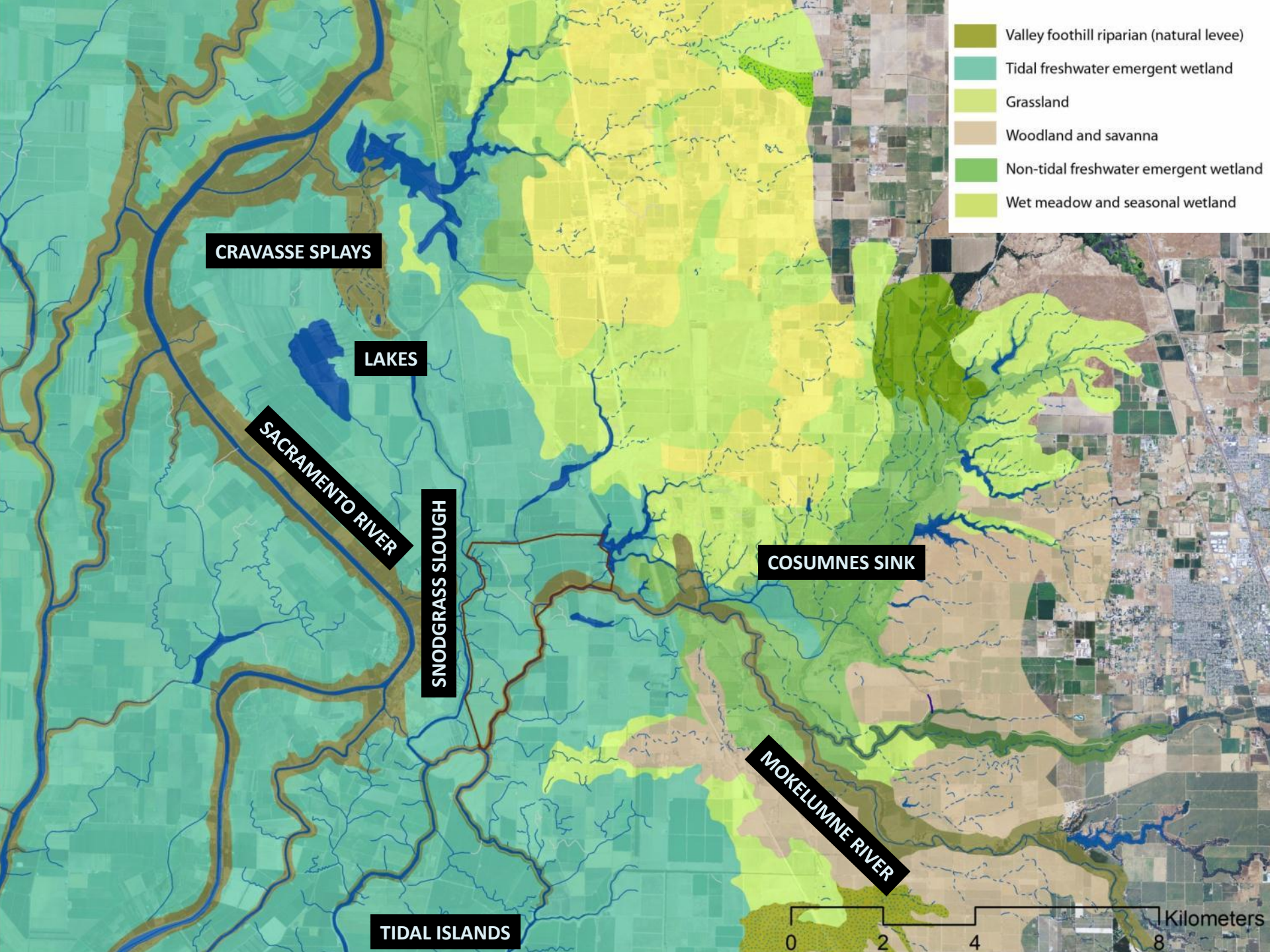

Sacramento River
Cosumnes River
Mokelumne River
North Fork Mokelumne River
South Fork Mokelumne River
Sacramento River


Sacramento River
Cosumnes River
PLEISTOCENE FAN
Mokelumne River
North Fork Mokelumne River
South Fork Mokelumne River
Sacramento River

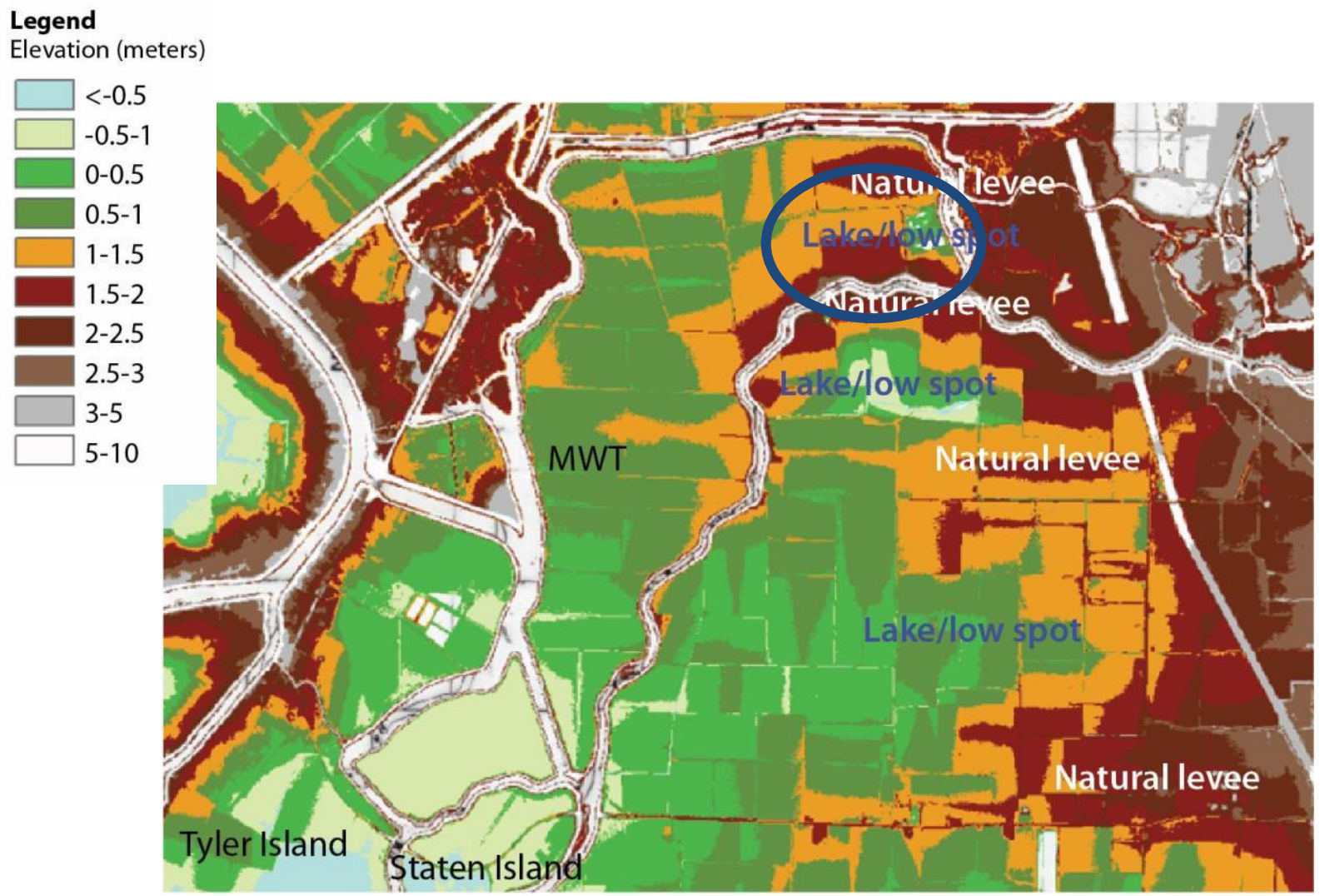

Sacramento River
NATURAL LEVEE
ELEVATED DURING HOLOCENE
NATURAL LEVEE
Cosumnes River
PLEISTOCENE FAN
SINK AND INCISION DURING HOLOCENE
Mokelumne River
North Fork Mokelumne River
South Fork Mokelumne River
Sacramento River



Adapted from Atwater and Belknap 1980
Pasternack and Brown 2004

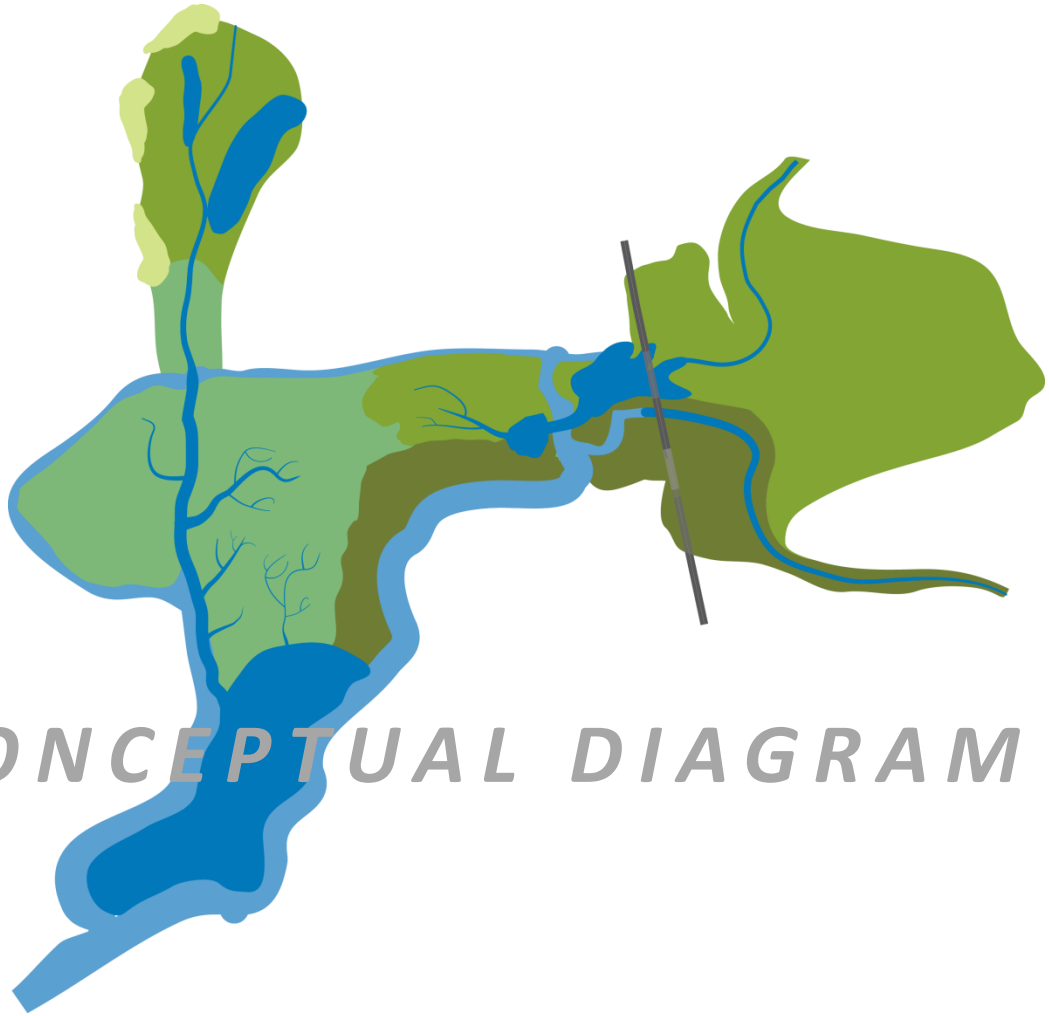

Valley foothill riparian (natural levee)
Tidal freshwater emergent wetland
Grassland
Woodland and savanna
Non-tidal freshwater emergent wetland
Wet meadow and seasonal wetland
CRAVASSE SPLAYS
LAKES
SACRAMENTO RIVER
SNODGRASS SLOUGH
COSUMNES SINK
MOKELUMNE RIVER
TIDAL ISLANDS
0
2
4
8
Kilometers

Topographic Variability

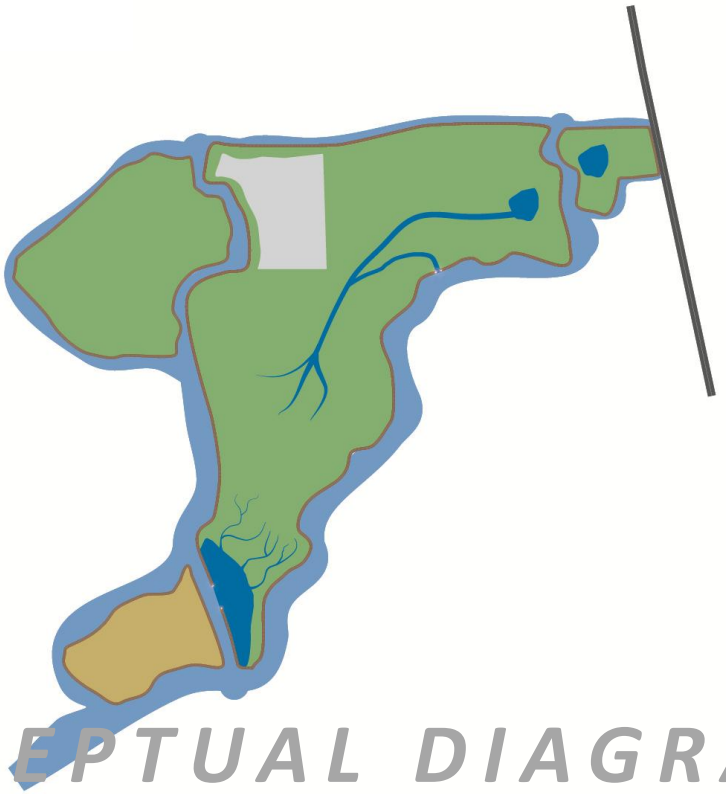


Potential Operational Landscape Unit for MWT Area

- Based on position w/in historical and projected future Delta landscapes
- Not yet using landscape metrics and fully developed conceptual landscape models

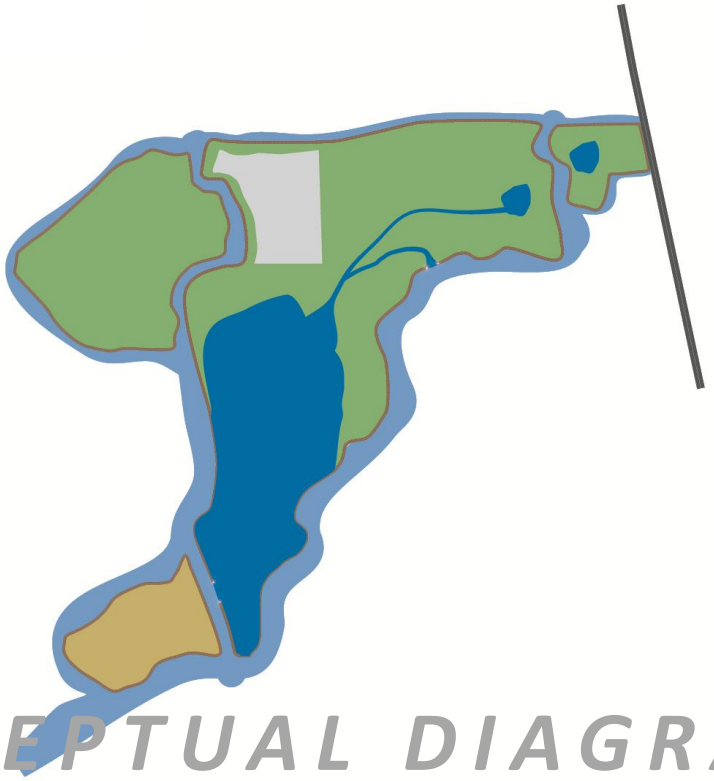


2025



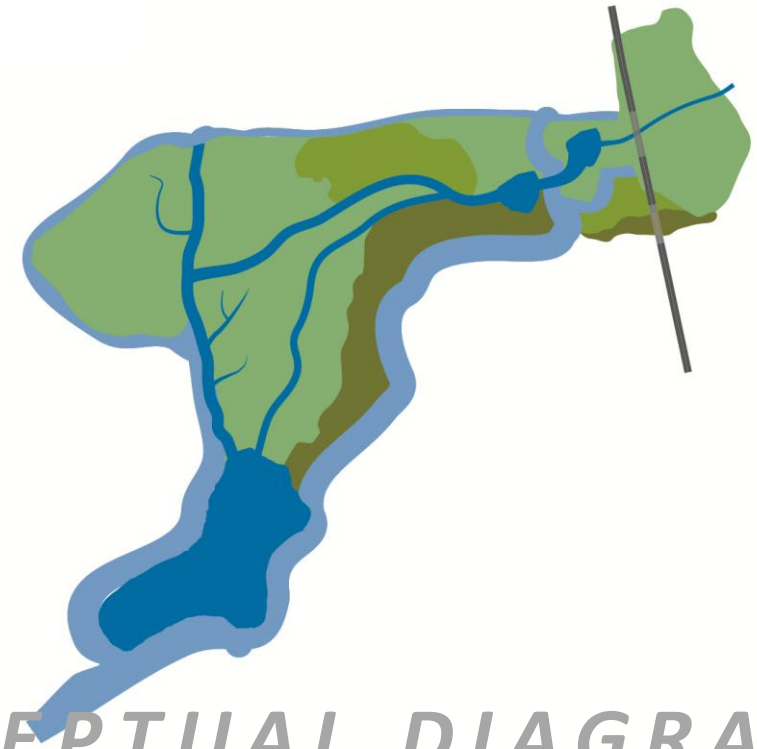
CONCEPTUAL DIAGRAM

2100



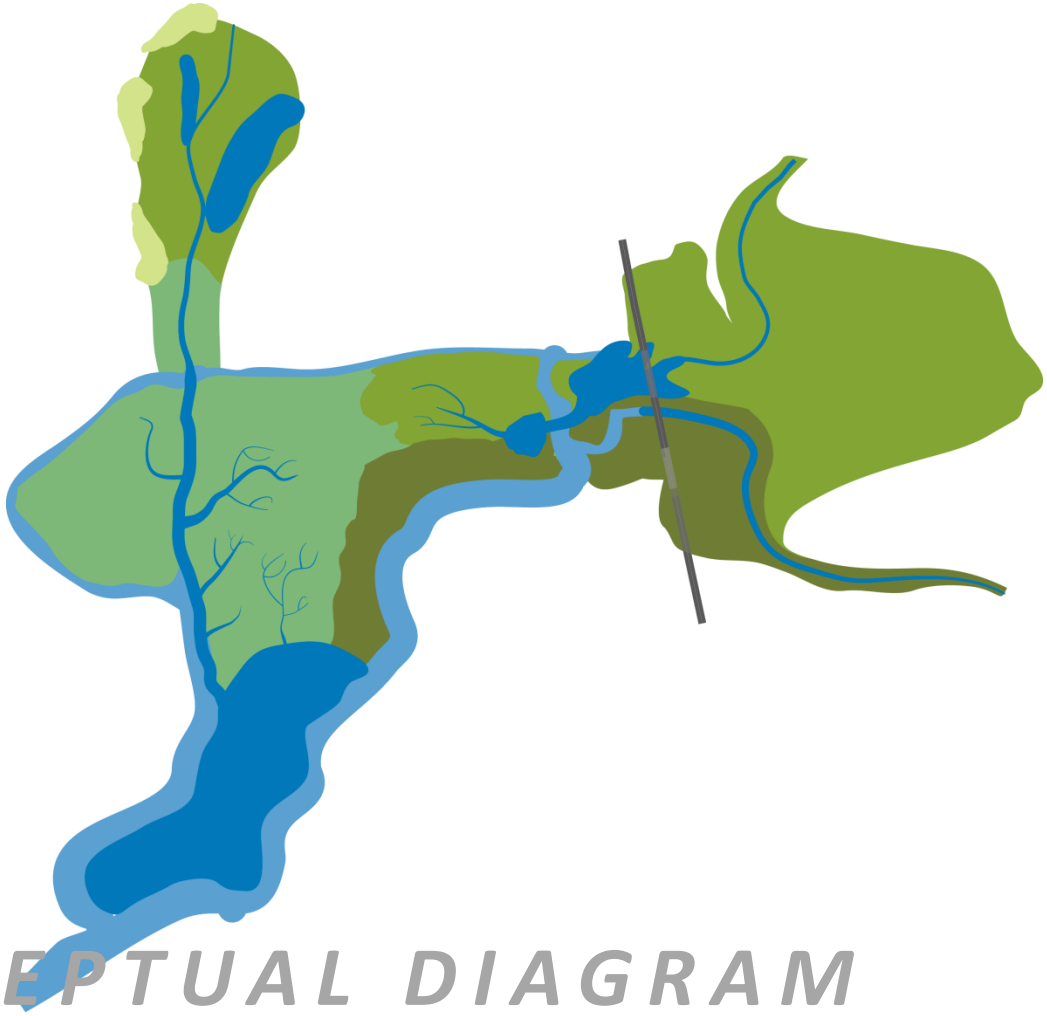
CONCEPTUAL DIAGRAM

2050



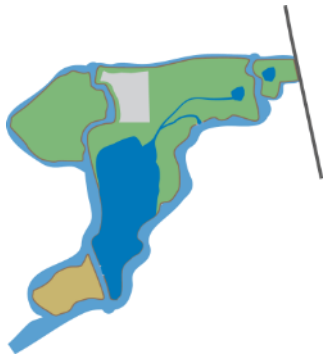
CONCEPTUAL DIAGRAM

2100



CONCEPTUAL DIAGRAM

MWT proposed



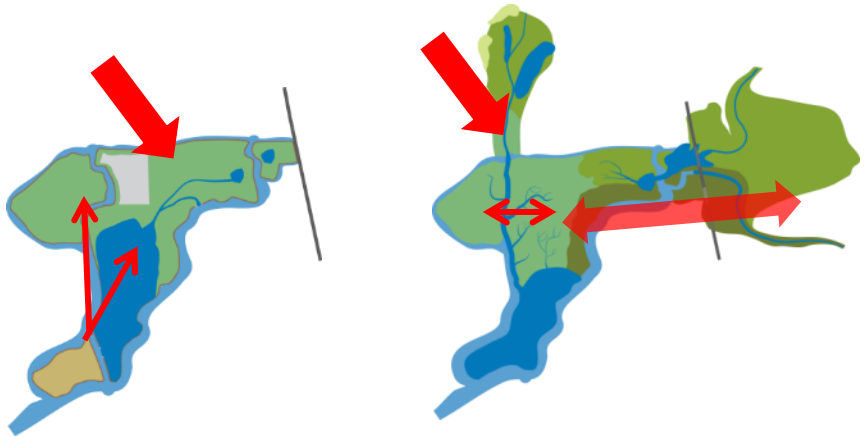
MWT as part of OLU

Habitat and Connectivity for Native Species

Tidal Marsh Area		
Riparian Width		

MWT proposed

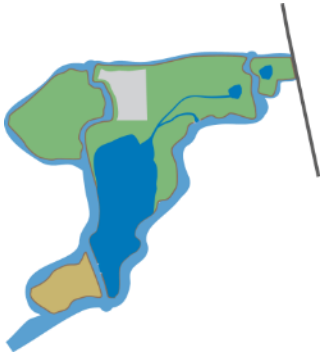
MWT as part of OLU



Connectivity for Fragmented Populations

Riparian Forest Connectivity		
Tidal Marsh Patch Size		
NND (to marsh for fish)		

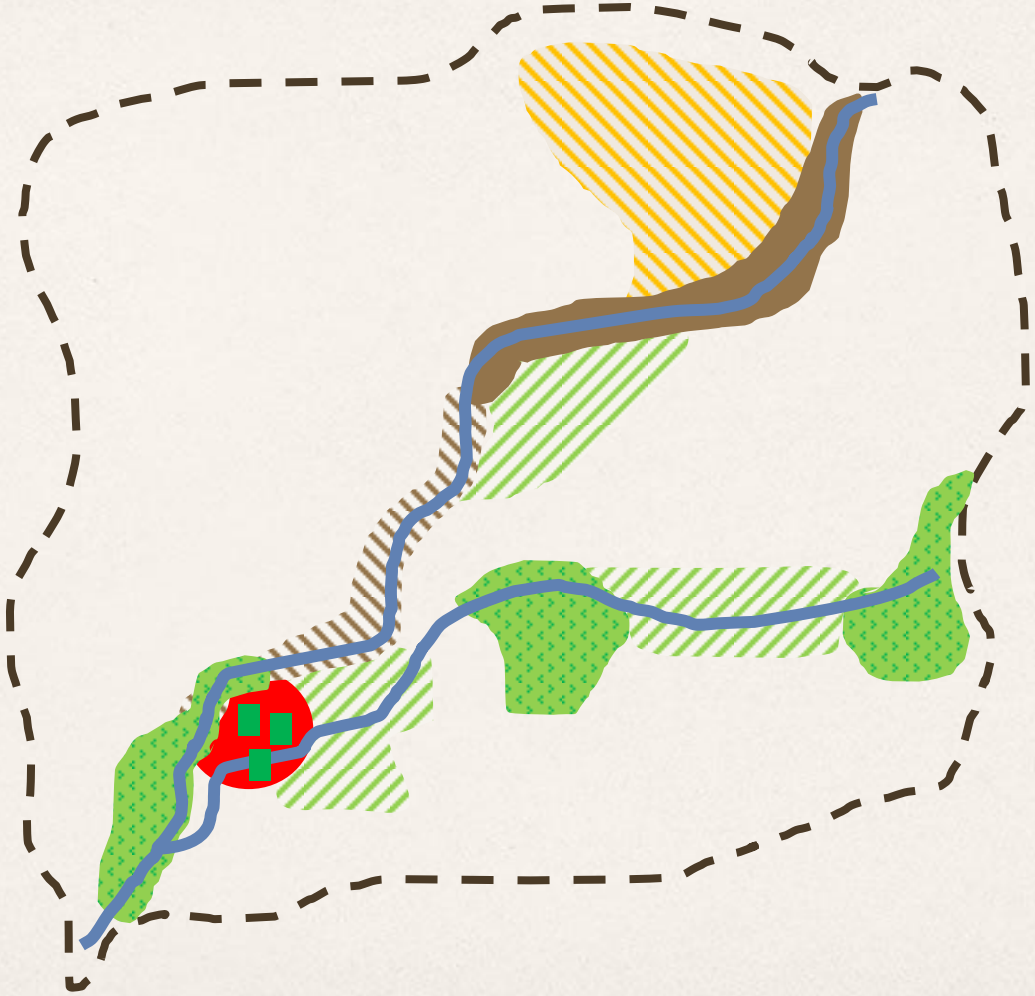
MWT proposed

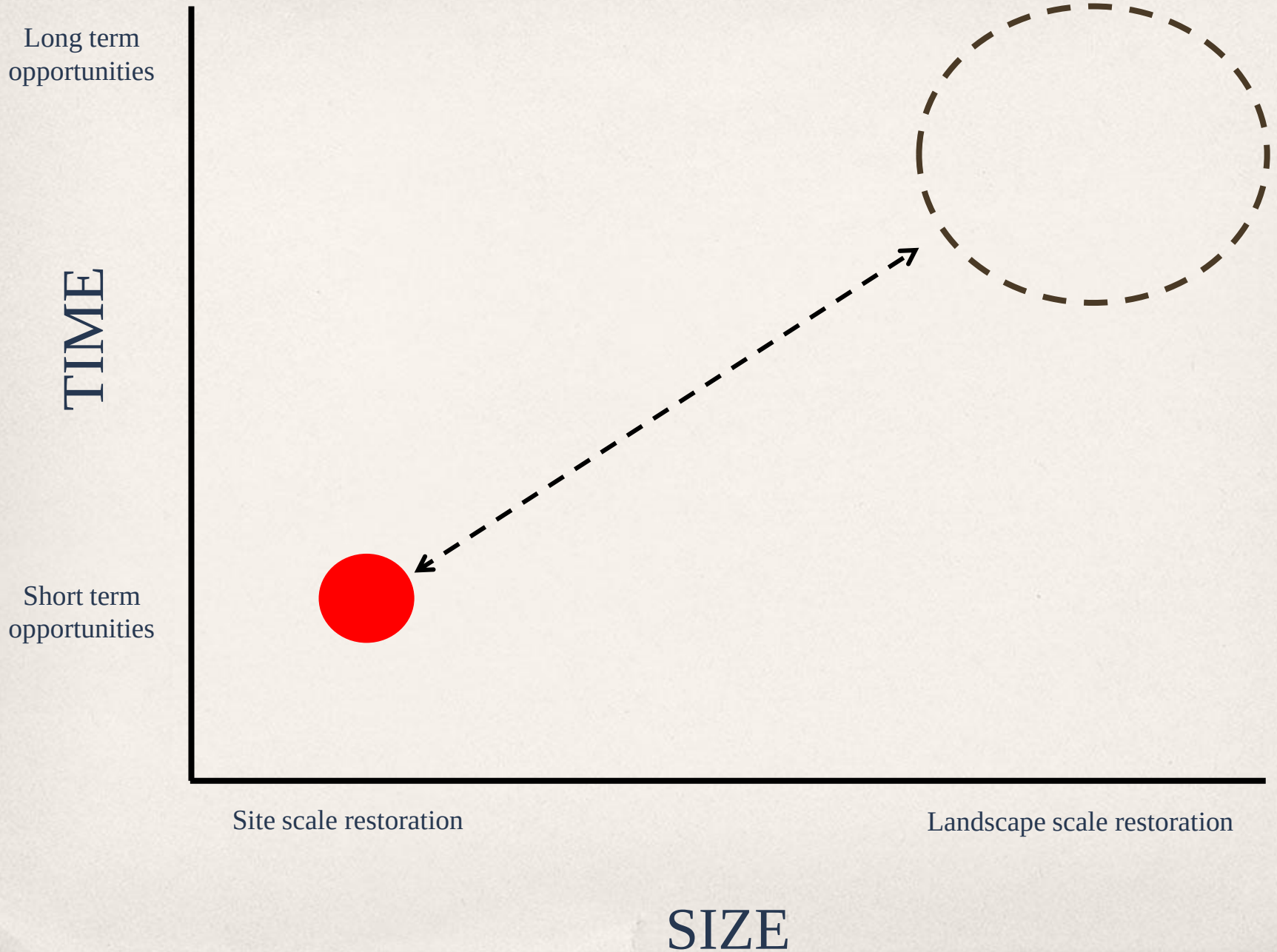


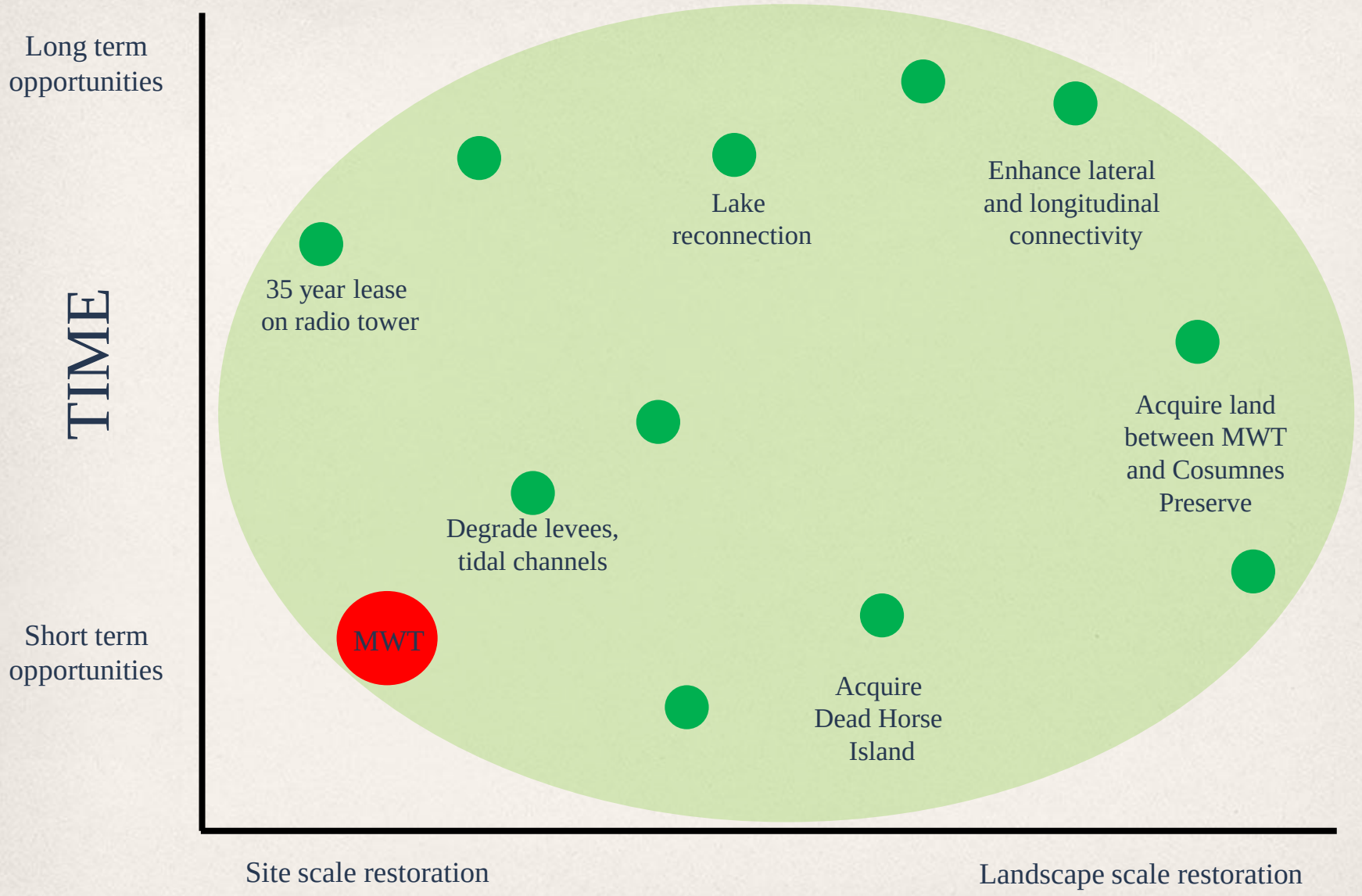
MWT as part of OLU

Biocomplexity/Adaptation Potential

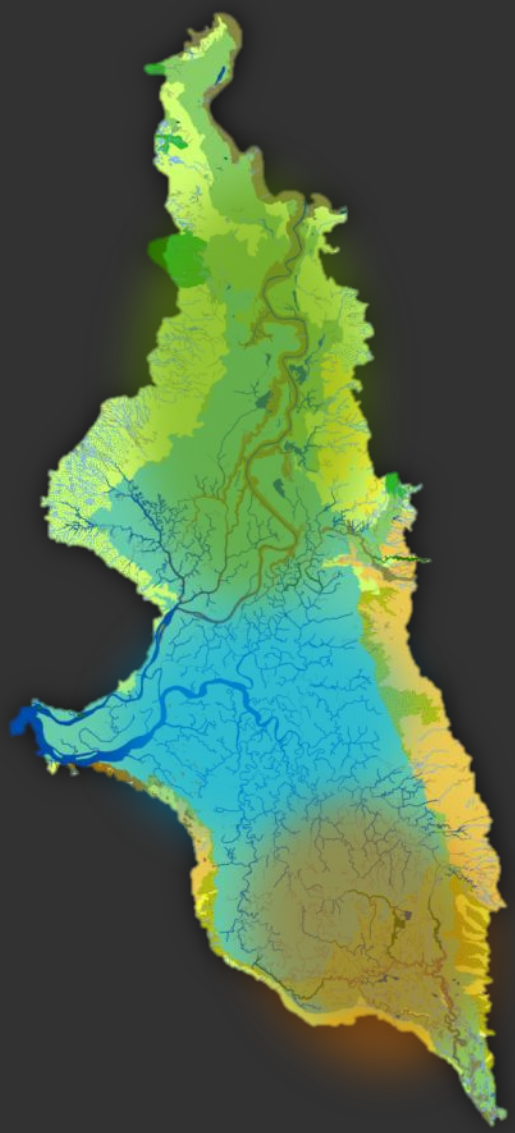
Habitat richness		
Continuous natural topo gradient (to 15m)		
Marsh area in 2100		

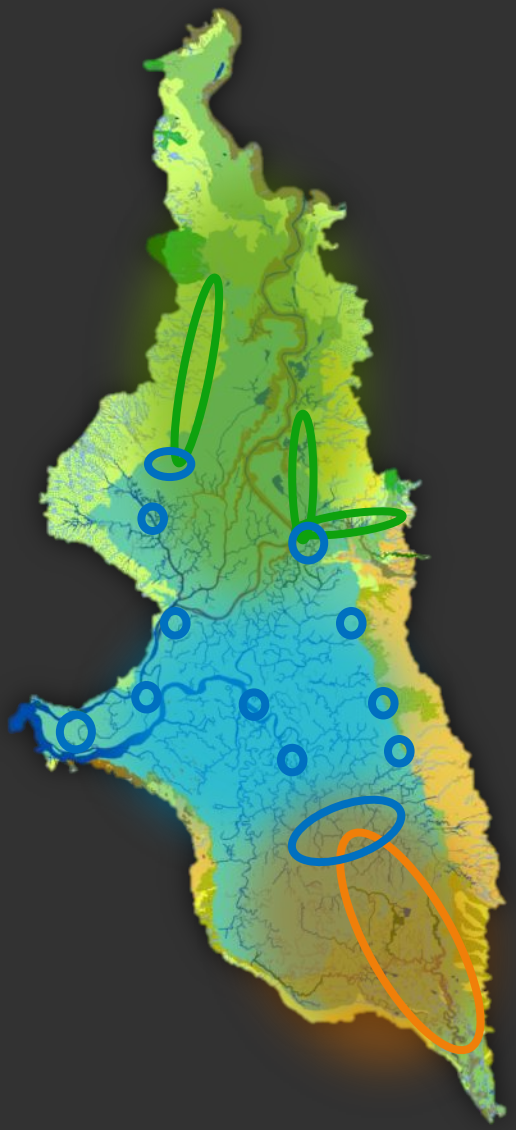



Long term opportunities
TIME
Short term opportunities
Site scale restoration
Landscape scale restoration
SIZE


Long term opportunities
TIME
Short term opportunities
35 year lease on radio tower
Lake reconnection
Enhance lateral and longitudinal connectivity
Acquire land between MWT and Cosumnes Preserve
Degrade levees, tidal channels
MWT
Acquire Dead Horse Island
Site scale restoration
Landscape scale restoration
SIZE

Scaling up to Full Delta: multiple, linked OLUs





Lessons from a historical perspective

- Large and interconnected habitats may mean different things for different places.
- Manage and plan with current and future expected physical gradients in mind.
- Think at the large scale and in the long term.
- The future will be different from both the present and the past, but emphasizing certain patterns and processes over others may yield a healthier ecosystem.

Timeline and products

Task	Description	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4
2.0	Historical and contemporary landscape analysis		**Metrics (past and present)**									
3.0	Description and comparison of past and present ecological function				**Maps, memo on change**							
4.0	Development of conceptual models, landscape-level restoration principles, and target metrics						**Conceptual models, restoration principles, possible scenarios memos**					
5.0	Communication and outreach							**Visuals, website, peer-reviewed paper**				

T H A N K S

SFEI

Ruth Askevold
Julie Beagle
Erin Beller
Josh Collins
Jamie Kass
April Robinson
Sam Safran
Micha Salomon

CDFW

Daniel Burmester
Carl Wilcox
Dave Zezulak

Cliff Dahm
Leo Winternitz
The LIT
CDFW, ERP, TNC for funding

robin@sfei.org

letitia@letitia.org